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Specification

THROTTLE DEVICE AND MOTOR THEREFOR

Technical Field

This invention relates to a throttle device and a motor therefor used to control the flow rate of air flowing into a cylinder of an internal-combustion engine.

Background Art

A throttle device wherein throttle valves disposed in an air-intake passage of a throttle body are electrically driven by a motor is already known. A body of the motor is housed in a motor casing, and the throttle body and the motor casing are formed as a single piece.

Proposed is the art of improving vibration resistance of such a body of the motor by fixing its front and rear ends in its radial direction (Both-end supporting structure). The following mechanisms for holding the output shaft and the rear end (an end opposite to the output-shaft side) of such a motor are disclosed.

According to Japanese Patent Laid-Open Nos. 2002-339766 and H10-252510, the rear end of the motor is held by adding components to the rear end of such a motor.

To put it more concretely, according to Japanese Patent

Laid-Open No. 2002-339766, a washer is used to hold the rear end of a motor. The washer is a ring of a plate spring. The washer has an inner edge (the plate spring) which is flexible in an axial direction by making slits in a radial direction thereof. The washer is press-fitted into a position close an inner bottom (a deep recess position) of the motor casing in advance of inserting the motor into the motor casing. Then, when the motor is inserted into the motor casing, the rear end side portion of the motor is inserted into inner circumference of the washer, causing the inner cut zone of the washer to bend backward. Thus, the rear end of the motor is held in its radial directions by the washer.

On the other hand, according to Japanese Patent Laid-Open No. H10-252510, the rear end of a motor is inserted into an elastic O-ring and the motor with the elastic O-ring is inserted into the motor casing. Thus, the rear end of the motor is held in its radial directions by the elastic O-ring in the motor casing.

In the case of the former prior art, when the motor is inserted into the motor, casing to bend the inner cut zone of the washer backward. During such motor insertion process, the outside of the motor body (yoke) may be scraped by the inner edge of the washer, and metal scraps may be produced. In addition, when inserting the motor into the motor casing, the motor may be inserted having dislingnment and held in such a state because

there is no means of aligning the center of the rear end of the motor. The disalignment of the center line of the motor with the center line of the motor casing means the disalignment of the motor's driving gears with a pinion gear and an intermediate gear and causes an error in mounting the motor.

In the case of the latter prior art, when the motor with the elastic O-ring is inserted into the motor casing, the elastic O-ring may be distorted or damaged.

The object of the present invention is to provide a throttle device with a motor, which is free from the above problems and of relatively simple construction.

Disclosure of the Invention

According to the present invention, in a throttle device with a motor for driving a throttle valve, the motor is housed in a motor casing provided in a throttle body. Additionally, an output-shaft side of the motor (here, it's also called as "front side or front end") is held in its radial directions in the vicinity of the motor casing's opening for inserting the motor into the motor casing. Another side (it's also called "rear side" or "rear end") opposite to the output shaft is provided with projections (elastic projections, for example), which are deformed inwardly in a radial directions. The motor and the elastic projections are formed in a single piece, or the elastic projections are attached to the motor body.

According to the deformation of the projection, the projections contact to the inside surface of the motor casing adding pressure, the rear end of the motor is held and fixed in its radial direction in the motor casing.

The elastic projections may be bent projections or lugs arranged circumferentially of the rear end of the motor.

With the above configuration, the motor is aligned with the motor casing immediately before the motor body is fully inserted into the motor casing; therefore, the motor can be properly aligned (alignment in its radial direction) with the throttle body.

When the motor is further inserted (fully inserted) into the motor casing, the elastic projections of the end opposite to the output-shaft side (rear end) of the motor are pressed down in the radial direction of the motor by the inside surface of the motor casing; thus, the rear end of the motor is held and fixed in its radial directions in the motor casing, the motor output shaft is kept precisely in parallel with an intermediate gear shaft and a throttle valve shaft. Therefore, the motor gear engages with the intermediate gear in good condition. That is, this arrangement is prevent from disalignment of the motor and no good mesh of gears with no good gear pitch due to such disalignment . As described above, the portion on the output-shaft side in the motor body is fixed to the throttle body, and the rear side of the motor body is

held and fixed in its radial directions by the pressed-down (preferably elastic) projections in the motor casing; therefore, the motor's vibration in its radial directions is held down. Thus, the vibration resistance of the motor is improved. As described above, the rear side portion of the motor is held and fixed inside the casing by the elasticity of the pressed-down elastic projections. Alternatively, the rear side portion of the motor may be held and fixed by similar projections, for example, which are press-fitted into the motor casing to be physically deformation.

Brief Description of the Drawings

Fig. 1 is a sectional view of a typical motor-driven throttle device (a device for controlling air intake for internal-combustion engines) of the present invention;

Fig. 2 is a perspective view of the throttle device of Fig. 1; wherein a section of part of the unit (motor casing) 1b is shown, and a perspective view of the throttle actuator (motor) removed from the motor casing is presented;

Fig. 3 is an illustration of the steps in the process of inserting the motor into the throttle body and assembling them; and

Figs. 4 to 8 are partially sectional views of other embodiments of the present invention.

Best Mode for Carrying Out the Invention

By referring to the drawings, a preferred embodiment of the present invention will be described below.

Fig. 1 is a sectional view of a typical motor-driven throttle devise (a device for controlling air intake flow rate for internal-combustion engines) of the present invention.. Fig. 2 is a perspective view of the throttle device of Fig. 1, wherein a part (motor casing) 1b of the device 1b is shown with a section view, and the throttle actuator (motor) removed from the motor casing 1b is shown with a perspective view. Fig. 3 is an illustration of the steps in the process of inserting the motor into the throttle body and assembling them.

The throttle body (also referred to as "main body" or "bore body") 1 shown in Figs. 1 to 3 is made by aluminum die-casting. Formed inside the throttle body 1 is a bore serving as an air-intake passage 1a. A throttle valve 2 is disposed in the air-intake passage 1a.

The throttle valve 2 is fixed to a throttle shaft 3, which is supported through the throttle body 1, by set screws 4. The throttle shaft 3 is supported rotatably with bearings 5a and 5b. The bearing 5a is held by the throttle body 1 and a retainer plate 6a. The bearing 5b is held by the throttle body 1 and a retainer plug 6b and one end face is covered.

A motor casing 1b is molded integrally together with the throttle body 1a. The yoke (motor body) 71 of the motor 7 for

driving the throttle valve is inserted into the motor casing 1b.

The motor 7 has an output shaft 70 in which one end (front side) protrude thorough the end bracket, and the output shaft 70a is provided with a pinion 8 for transmitting power from the motor 7 to the throttle shaft 3.

An intermediate gear 9 for transmitting power from the motor is fitted on a shaft 11 being press-fitted into the throttle body 1. A throttle gear 10 is fixed on the front end of the throttle shaft 3 by a skirt nut 12. The gears 8, 9, and 10 constitute a reduction device for transmitting power from the motor 7 to the throttle shaft 3. They are covered in a sealed state with a packing 14 and a gear cover 13 attached to the throttle body 1.

The gear cover 13 is made of synthetic resin. The gear cover 13 has a metal motor-driving terminal 13a and a throttle-sensor terminal 13b, the terminals 13a and 13b together provided into the cover 13 by insert molding. In this way, the gear cover is provided with a so-called directly mounting connector 13c and a throttle sensor. The throttle sensor has a rotor 20 and a resistor 19. The rotor 20 is fitted to one end side part of the throttle shaft 3. The rotor 20 has a brush 13b, which is in contact with the resistor 19 of the sensor. The throttle-sensor resistor 19 and the throttle-sensor terminal 18 are held by U-clip having spring elasticity. Thus,

the resistor 19 and the throttle-sensor terminal 18 are electrically connected by mechanical contact. The art of driving and controlling a throttle valve with an electric motor is well known; therefore, the explanation of the art is omitted.

As shown in Fig. 1, a numeral 15 is a return spring, a numeral 16 is a default lever, and a numeral 17 is a default spring.

The arrangement for holding the motor 7 for the throttle device will be detailed below.

In the motor 7 of the present embodiment, a motor body 71 is inserted into the motor casing 1b through a motor-insertion opening 73. The one end portion 72 (flange 7b) on the output shaft side of the motor 7 is held and fixed in its radial direction in the vicinity of the motor-insertion opening 73 of the motor casing 1b. The other end portion 74 opposite to the output shaft side of the motor 7 is held in motor's radial direction by the inner surface of the motor casing 1b through the use of elastic pieces 7c (it may be so "flexible pieces"; refer to Figs 2 and 3). The motor body and the elastic pieces are formed in a single-piece design (or the elastic pieces are attached to the motor as shown in other embodiments to be described later). The elastic pieces are elastic-deformed inwardly in the radial direction of the motor by pressure from the inner surface of motor casing 1b.

As shown in Fig. 2, the elastic pieces (namely flexible

pieces or springy pieces) 7c and a bearing bracket 7a opposite to an output-shaft side (rear end) of the motor are formed in a single-piece design. The elastic 7c are configured by bent-pieces which are formed on an outer edge of the bearing bracket 7a by sheet-metal working. Although there are four elastic pieces (bent pieces like metal plate springs) 7c at evenly spaced intervals in Fig. 2, the number and arrangement of spring pieces 7c are not limited to them.

The bent pieces 7c extend radially from the outer edge of the bearing bracket in a state before bending working, and they are formed by being bent from the motor rear side toward the motor front side (output-shaft side of the motor). The bending direction of the bent pieces is opposite to the direction of inserting the motor. Each bent piece 7c has a curved surface (see Fig. 3).

Immediately before the motor 7 is fully inserted into the motor casing 1b, part of the curved outer surfaces of the bent pieces 7c come into contact with a tapered surface 1f inside the motor casing 1b and are pressed down inwardly in the radial direction of the motor.

The above pressing will be detailed later when the process of installing the motor body into the motor casing is described by referring to Fig. 3. When pressed down, the bent pieces 7c are elastically deformed (flexibly deformed) inwardly in the directions of the motor. Due to such elastic deformation,

the bent pieces 7c come into notches 75 which are made in the yoke 71 of the motor 7.

The motor casing 1b is configured by a cylindrical casing in which one end thereof is closed, and the other end thereof is provided with the motor-insertion opening 73. Inside of the motor casing 1b has a tapered surface (1e, 1f) tapering down from the motor 7-insertion opening side to toward the side opposite to the motor-insertion opening. In this embodiment, the tapered surface is configured with a first tapered surface part 1e making up a sizable proportion thereof (it extends from the motor-insertion opening side toward the deep recess-portion of the motor casing) and a second tapered surface part 1f following the first tapered surface part 1e at the deep recess-portion.

The slope of the second tapered surface 1f is larger than that of the first tapered surface 1e. When the motor 7 is fully inserted into the motor casing 1b, the rear end of the motor 7 is positioned at the non-tapered inner surface part 1c between the second tapered surface part 1f and the rear end (inner bottom) 1h of the motor casing 1b as shown in Figs. 1 and 3. The non-tapered inner surface part 1c is formed in a straight cylindrical-inner surface shape.

As shown in Fig. 3, there is a gap between the outer surface of the motor 7 and the motor casing-inner surface comprising the first tapered surface part 1e, the second tapered surface

part 1f and the non-tapered inner surface part 1c. The sum R1 of outer diameter of the motor-body 7 and the height at the highest points of the curved outer surfaces of the bent pieces 7c before the bent pieces (elastic pieces) are elastically deformed is larger than the inner diameter R2 at a halfway point "P" on the second tapered surface part 1f. But the sum diameter R1 is smaller than the inner diameter R3 at any point of the range from the first tapered surface part 1e up to a position immediately before the halfway point "P" of the second tapered surface part 1f. Accordingly, the bent pieces 7c come into contact with the second tapered surface 1f immediately before the motor 7 is fully inserted into the motor casing 1b as shown in Fig. 3 (3). Then, as the motor 7 is fully inserted into the motor casing 1b, the bent pieces 7c are pressed down by the second tapered surface part 1f and are elastically deformed in the inner radial direction of the motor.

Because the bent pieces 7c have a curved outer surface, their curved outer surfaces comes into contact with the second tapered surface 1f of the motor casing 1b and, thus, the bent pieces 7c are pressed down.

A motor guide 1d for guiding motor inserting are formed in the vicinity of the motor-insertion opening 73 of the motor casing 1b. As shown in Fig. 2, the motor guide 1d is configured by plural guide projections formed in the vicinity of the motor-insertion opening 73, and have arc-shaped inner faces

respectively. The end on the output-shaft side of the motor 7 is restrained in the radial direction by the ark-shaped inner face of the motor guide 1d (for example, a part 7b′ (see Fig. 2) of a motor-mounting flange 7b of the motor body 71 are put into contact with the arc-shaped inner faces of the motor guide 1d). Parts 7b″ (the parts made longer than the part 7b′ in the radial direction) of the flange 7b are positioned between motor guide projections 1d. Each parts 7b″ has a screw-through hole 80 (see Fig. 2), and the motor 7 is secured to the throttle 1 by screws using the screw-through holes 80.

The parts 7b′ (having smaller diameters than the parts 7b″) of the flange 7b are clearance-fitted into the motor-guide (flange guide) 1d immediately before the motor 7 is fully inserted into the motor casing 1b. Thus, the end on the output-shaft side 72 of the motor 7 is fixed in its radial direction.

By referring to Fig. 3, the process of mounting the motor 7 into the motor casing 1b will be described below.

In Fig. 3, the reference sign "L1" is a distance from a point p1 to the end of the motor guide projections (motor guide) 1d. The point P1 is a point where elastic pieces (bent pieces) 7c of the motor 7 first come into contact with the second tapered surface 1f during the motor insertion process. "L2," is a distance from the point "P" to the flange 7b on the output-shaft side. L1 is equal to or larger than L2).

As the motor 7 is inserted into the motor casing 1b, the motor 7 moves from the position shown in Fig. 3 (1) (the position before the bent pieces 7c reach the contact point "P") to the position shown in Fig. 3 (2). Fig. 3 (2) shows the position of the motor 7 immediately before it is fully inserted into the motor casing 1b, namely the position of the motor 7 where the bent pieces 7c reach the contact point "P" on the second tapered surface 1f. At the time, because L1 is not shorter than L2, the outer edge of the flange 7b (the end on the output side of the motor) is clearance-fitted into inner faces of the motor guide projections 1d.

Thus, in the step of inserting the motor 7 into the motor casing 1b shown in Fig. 3 (2), the motor flange 7b is supported by the motor guide projections 1d. On the other hand, the center of the end 74 opposite to the output-shaft side of the motor 7 is aligned with the center of the motor casing 1b by the bent pieces 7c coming into contact with the second tapered surface 1f.

Then, when the motor 7 is fully inserted into the motor casing 1b, the bent pieces 7c are pressed down by the second tapered surface 1f and, then, by the non-tapered inner surface 1c as shown in Fig. 3 (3) and are elastically deformed (flexibly deformed) inwardly of the radial direction of the motor. Thus, the bent pieces 7c partially enter the notches 75 and the rear end 74 of the motor body 71 is firmly held in the inner surface

1c of the motor casing by the elasticity (springy force) of the pressed-down bent pieces 7c.

In the above step of full insertion, the motor flange 7b is guided by the motor guide projections 1d; therefore, the motor 7 is fully inserted into the motor casing 1b correctly.

Thus, the precision in assembling the motor 7 and vibration resistance of the motor 7 are improved. Besides, as the bent pieces 7c and the motor 7 are formed as a single piece, the number of parts is relatively small and the assembling process of the motor 7 is relatively simple. Moreover, because the elastic pieces 7c have a curved outer surface and the halfway parts of curved outer surfaces are pressed down by the second tapered surface 1f (inside of the casing), the elastic pieces 7c do not scrape the inside of the motor casing 1b, producing no metal scraps.

Figs. 4 to 8 are partially sectional views of other embodiments of the present invention. The same reference numerals and signs commonly used between Figs. 1 to 3 stand for the same components and elements. The differences from the first embodiment will be described below.

In Fig. 4, the motor body 71 as a yoke is provided with elastic pieces 7e. The elastic pieces 7e such as lugs are formed by cutting and raising parts of the yoke 71 of the motor 7. As in the case of the first embodiment, the elastic pieces 7e are arranged in a circumferential direction of the yoke 71.

The relation between "L1" and "L2" of the first embodiment that "L1" is not shorter than "L2" holds true in this embodiment.

In Fig. 5, the yoke 7 is fitted with a ring (a part different from the yoke) 7f' with elastic pieces (flexible pieces like plate springs) 7f. The elastic projections (lugs) 7f are formed and arranged in a circumferential direction of the ring 7f' by cutting parts of the ring 7f' in the shape of a lug and raising them.

In Fig. 6, the bearing boss 77 at the rear end of the motor 7 is fitted with a ring 7g' with elastic pieces 7g (or elastic projections). This ring 7g' has the same workings and effect as the rings of the other embodiments. In this embodiment, the contact point "P" of the elastic pieces 7g is somewhere on the inner surface of the boss 77. Also, the previously described relation between "L1" and "L2" that "L1" is not shorter than "L2" holds true in this embodiment. Thus, the present embodiment has the same workings and effect as those of the previously described embodiments.

Figs. 7 and 8 show other embodiments. In Fig. 7, one end of the yoke 7 is provided with a circumferential groove 79, and an O-ring (elastic member) 15a is fitted therein. The O-ring has the same effect as that of the previously described elastic pieces. The previously described relation between "L1" and "L2" that "L1" is not shorter than "L2" also holds true in this embodiment.

In Fig. 8, the bearing boss 78 at the rear end of the yoke 7 is provided with a circumferential groove 79', and an O-ring 15b is fitted therein. In this embodiment, the contact point "P" of the O-ring 15b is somewhere on the inner surface of the boss 78. The previously described relation between "L1" and "L2" that the L1 is not shorter than "L2" also holds true in this embodiment. Further, the present embodiment has the same workings and effect as those of the previously described embodiments. In addition to metal materials, the elastic pieces, rings, etc. may be made of synthetic resin. The present invention is not limited to the above embodiments, and various types of elastic pieces, elastic projections, etc. are applicable.

Industrial Applicability

According to the present invention, a throttle device and a motor therefor in which vibration resistance of the motor and the precision in assembling the motor (precision of alignment of the motor) are improved with simple configuration can be provided.